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Vicksburg District

Nitrogen Processes in Large Rivers Workshop

23-24 August 2005

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Watershed Approach to Stream Stability and Benefits Related to the Reduction of Nutrients



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Mississippi Delta Headwater (MDH) Project



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Purpose of MDH Project

- Erosion Control
- Sediment Management
- Flood Control
- Environmental Enhancement
- Demonstrate Innovative Technologies for Watershed Treatment



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Mississippi Delta Headwater (MDH) Project

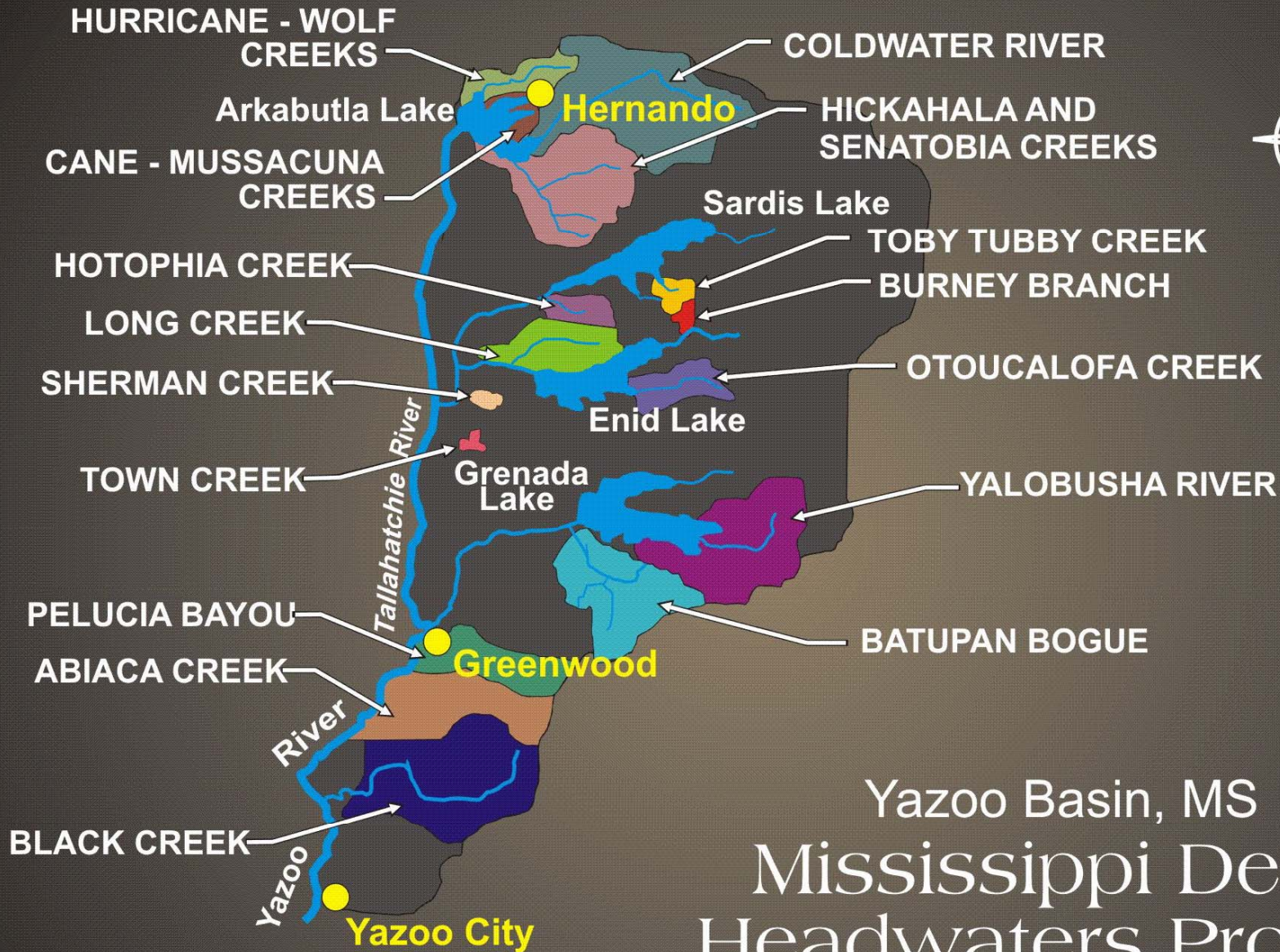
- Highly erosive soils of Yazoo River Basin foothills
- Six original watersheds, 9 added in '88, 16th (Yalobusha) added in '97
- Systems Approach



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Participating Agencies

- Corps of Engineers, Vicksburg District
- NRCS
- Engineer Research Development Center
- USDA Sedimentation Laboratory
- University of Mississippi Center for Computational Hydraulics
- USGS



Yazoo Basin, MS

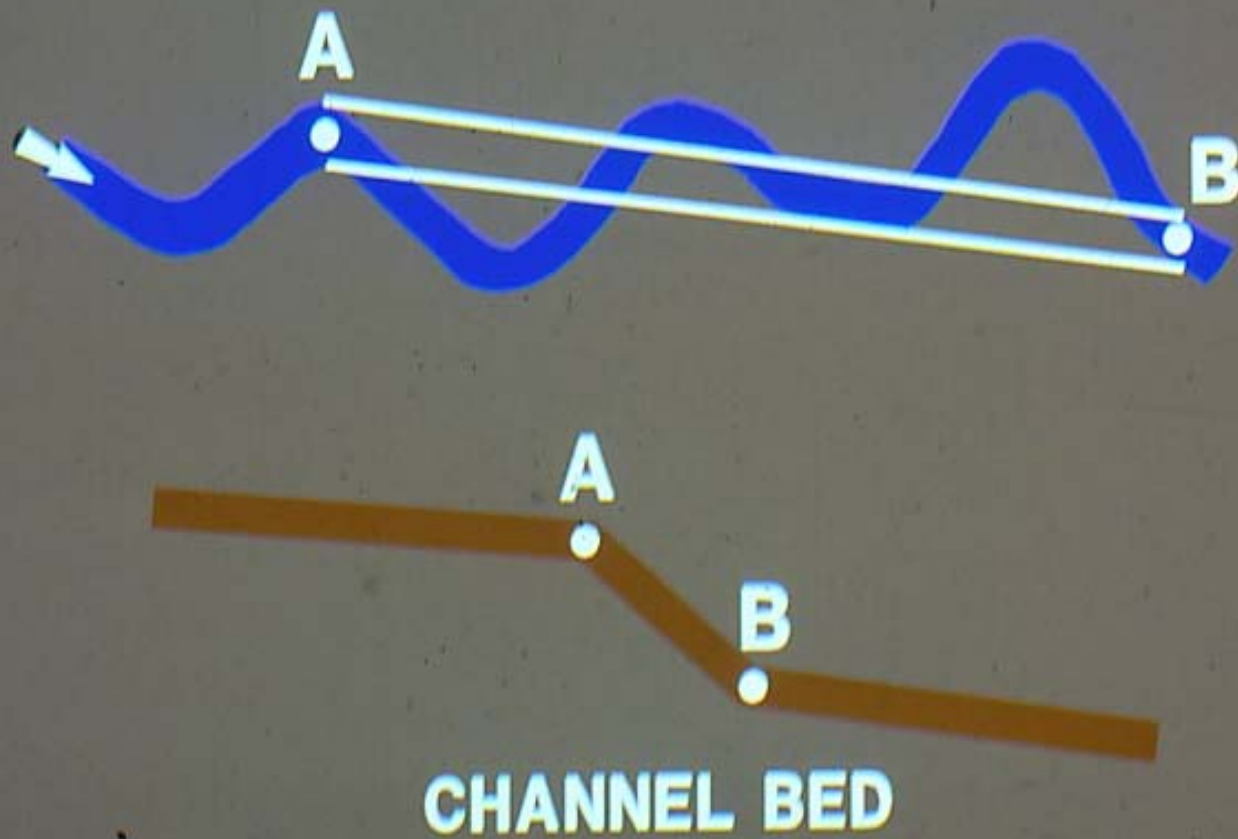
Mississippi Delta Headwaters Project

(Demonstration Erosion Control)

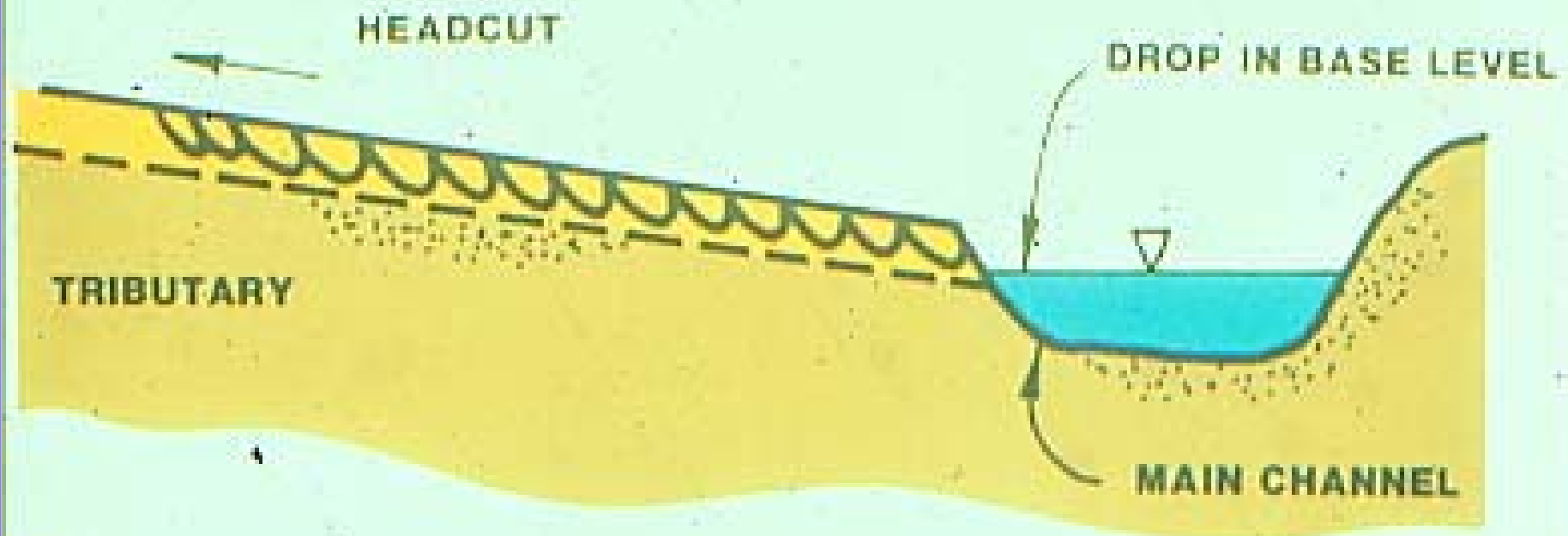


Channel Straightening

EFFECT OF CHANNELIZATION



$$Q^0 S^+ \propto Q_S^+ D_{50}^0$$



**LOWERING OF BASE LEVEL FOR
TRIBUTARY STREAM (AFTER SIMON, 1977)**



Headcut



Knickzone



Effects of Degradation



Effects of Degradation



Effects of Degradation



Effects of Bank Erosion



Gully Erosion



Channel Degradation



Deposition in Lower Reaches



Levee Break



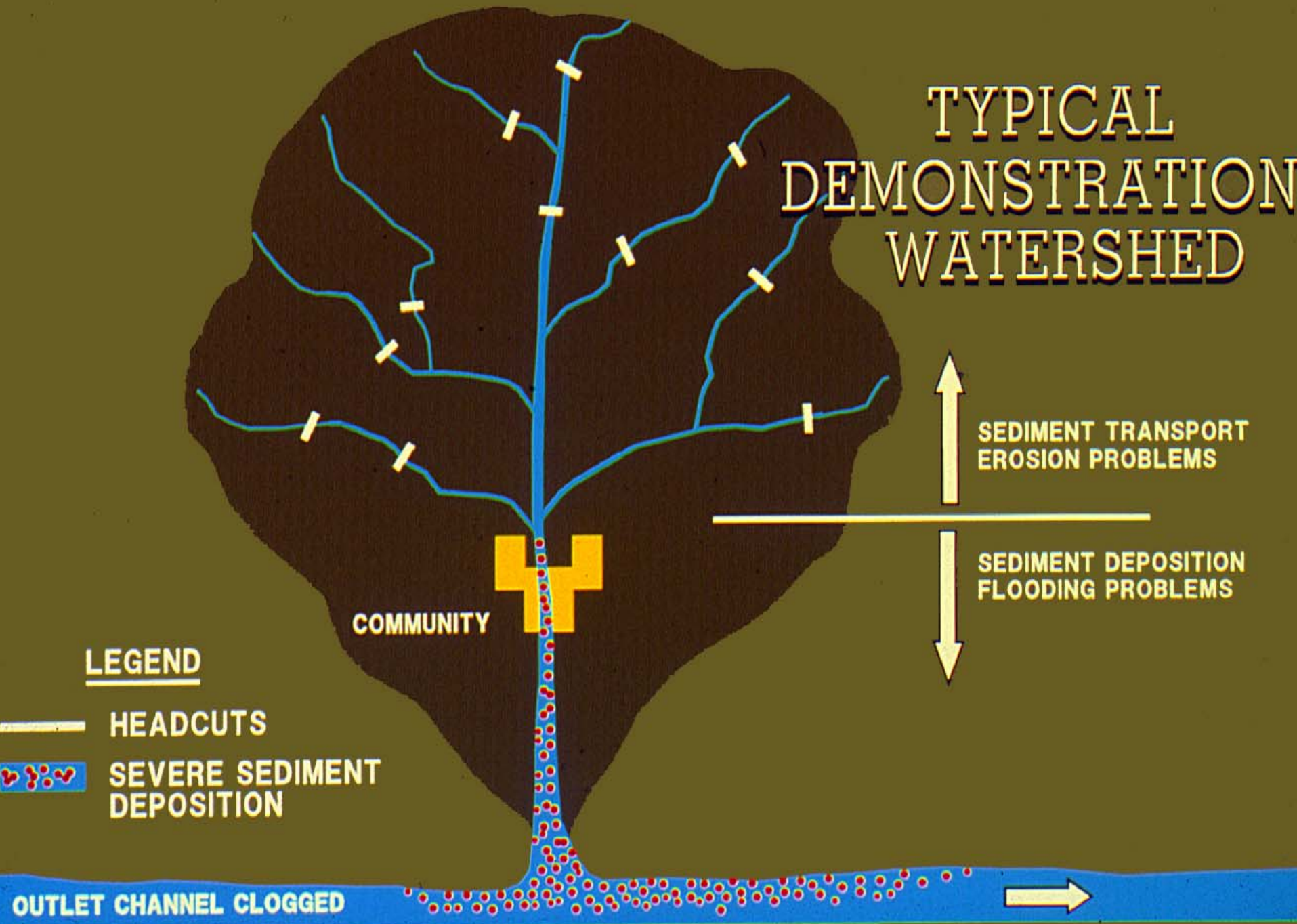
One Corps Serving the Armed Forces and the Nation



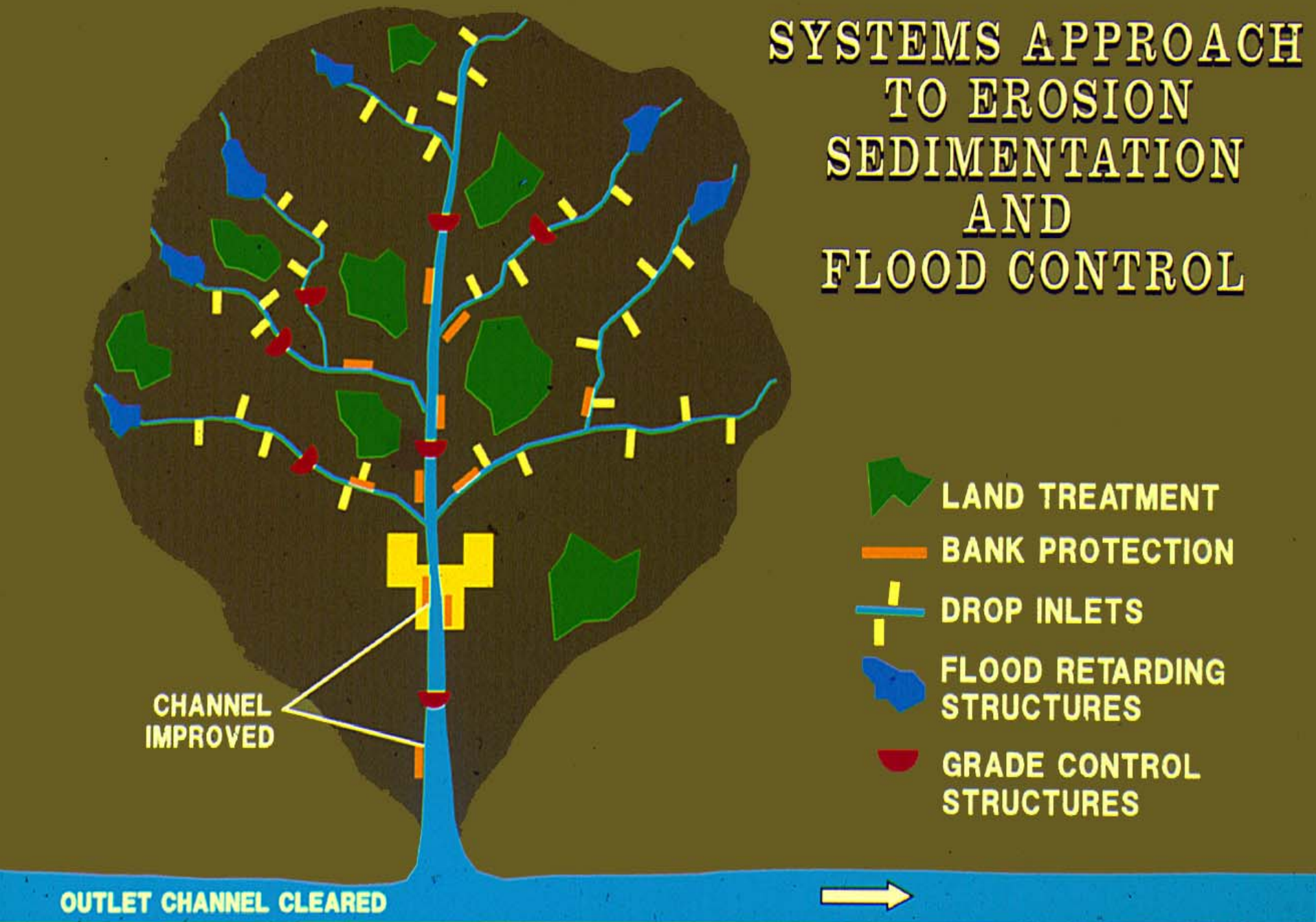
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Systems Approach to Watershed Analysis

TYPICAL DEMONSTRATION WATERSHED



SYSTEMS APPROACH TO EROSION SEDIMENTATION AND FLOOD CONTROL

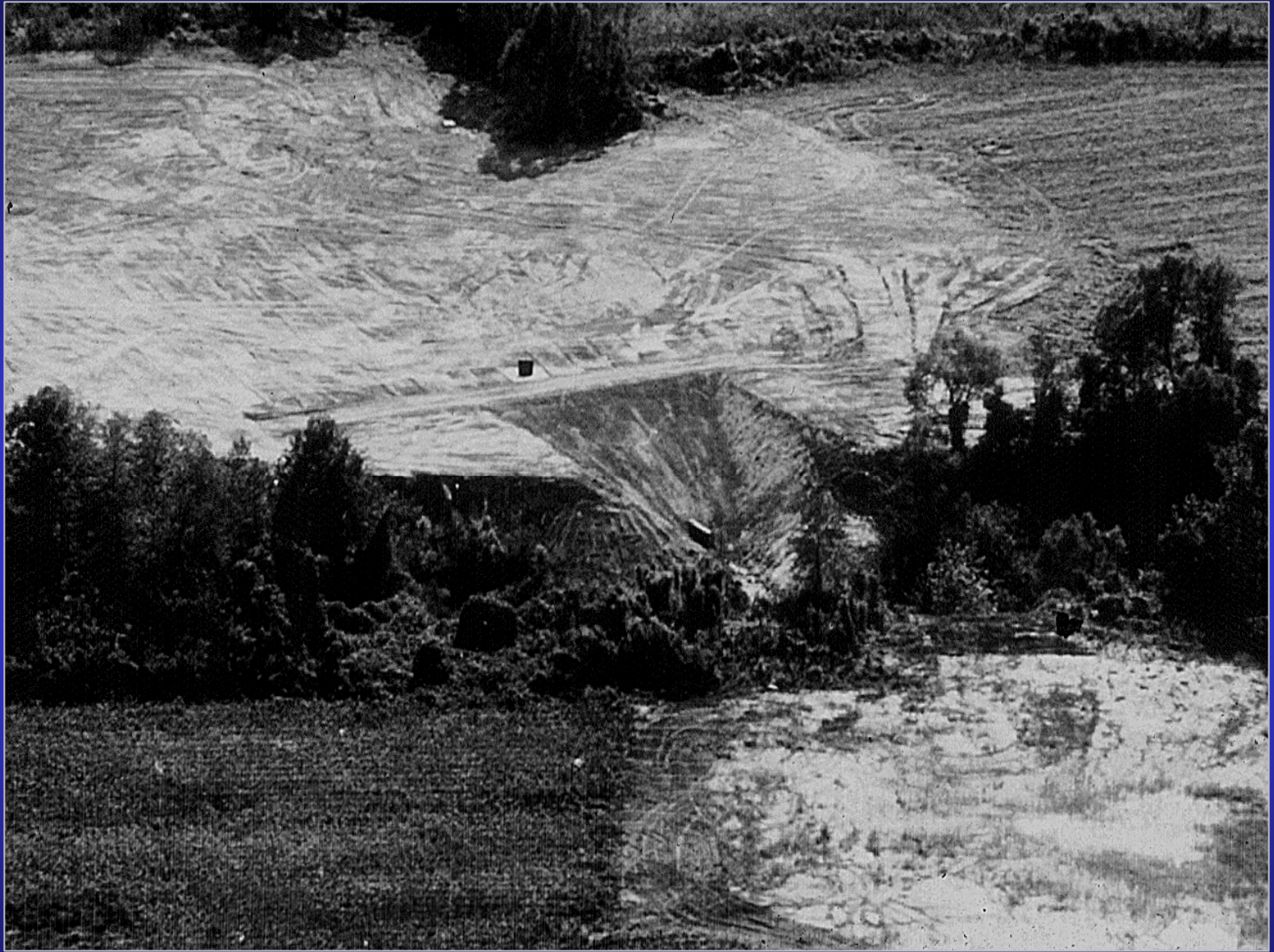




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Typical MDHP Structures

- Grade Control Structures
- Riser Pipes
- Bank Stabilization
- Floodwater Retarding Structures



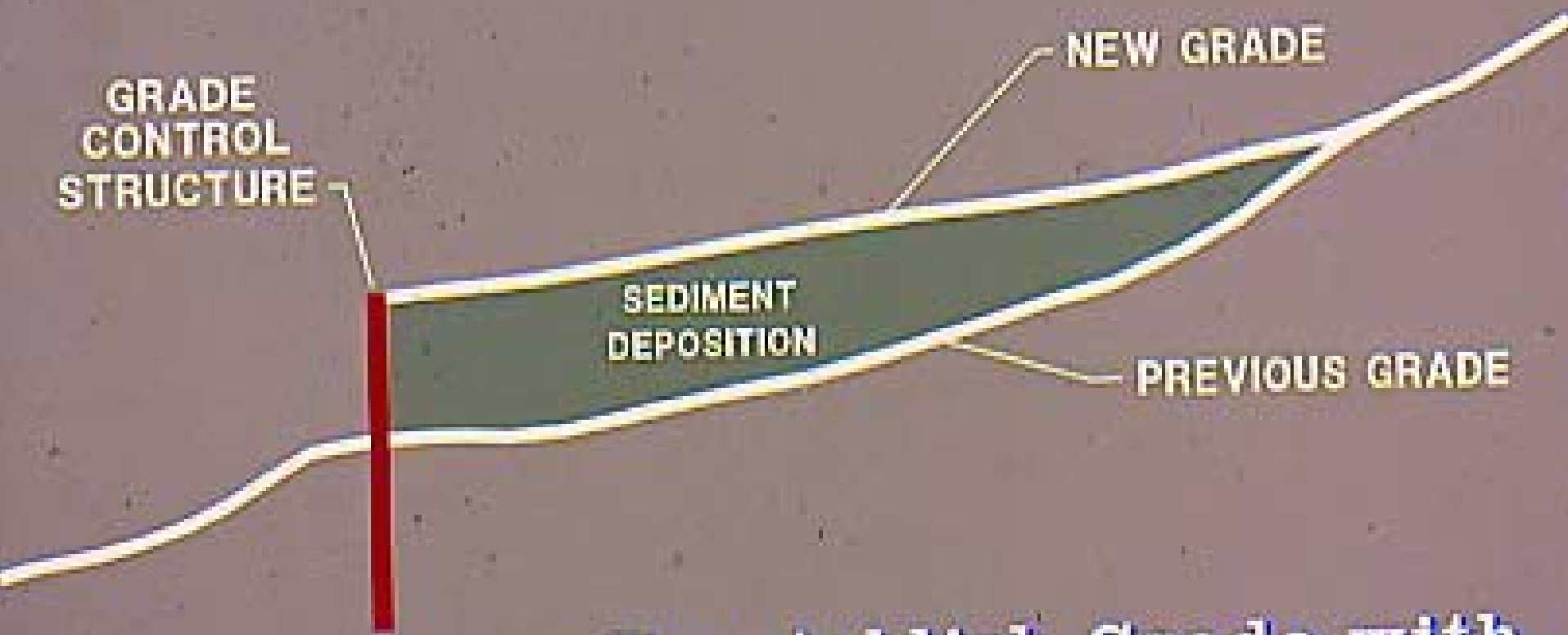
Riser Pipe



Bank Stabilization



Bank Stabilization

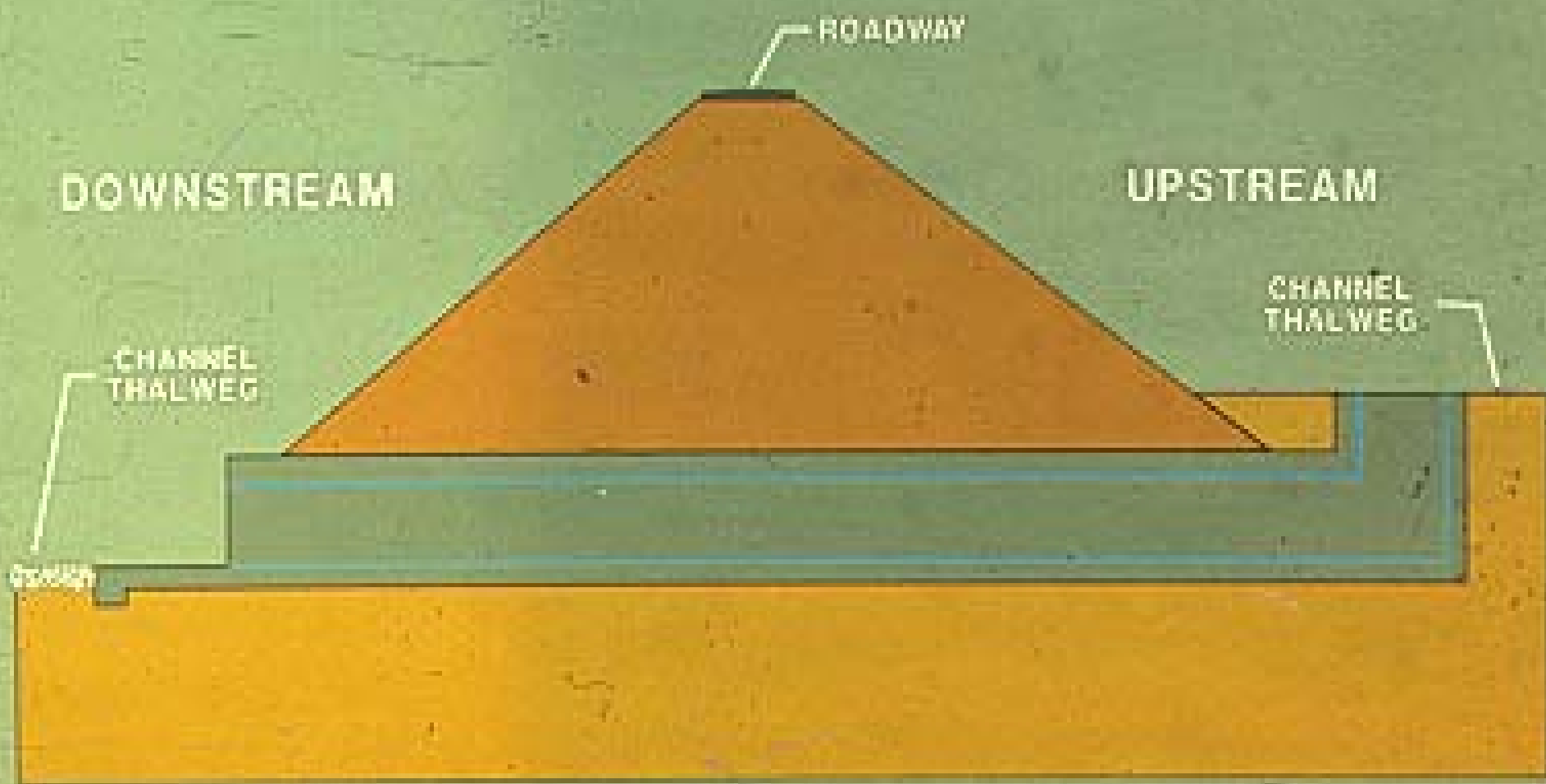


**Reestablish Grade with
Grade Control Structure**



Low Drop Grade Control Structure

BOX CULVERT GRADE CONTROL STRUCTURE





Box Culvert Grade Control Structure



High Drop Grade Control Structure



Floodwater Retarding Structure



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MDHP Monitoring Program



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MDHP Monitoring

- 33 monitoring sites (40 miles of stream)
- Field investigations and surveys
- Data collection
- Geomorphic, hydraulic, and sediment transport analyses
- Environmental studies

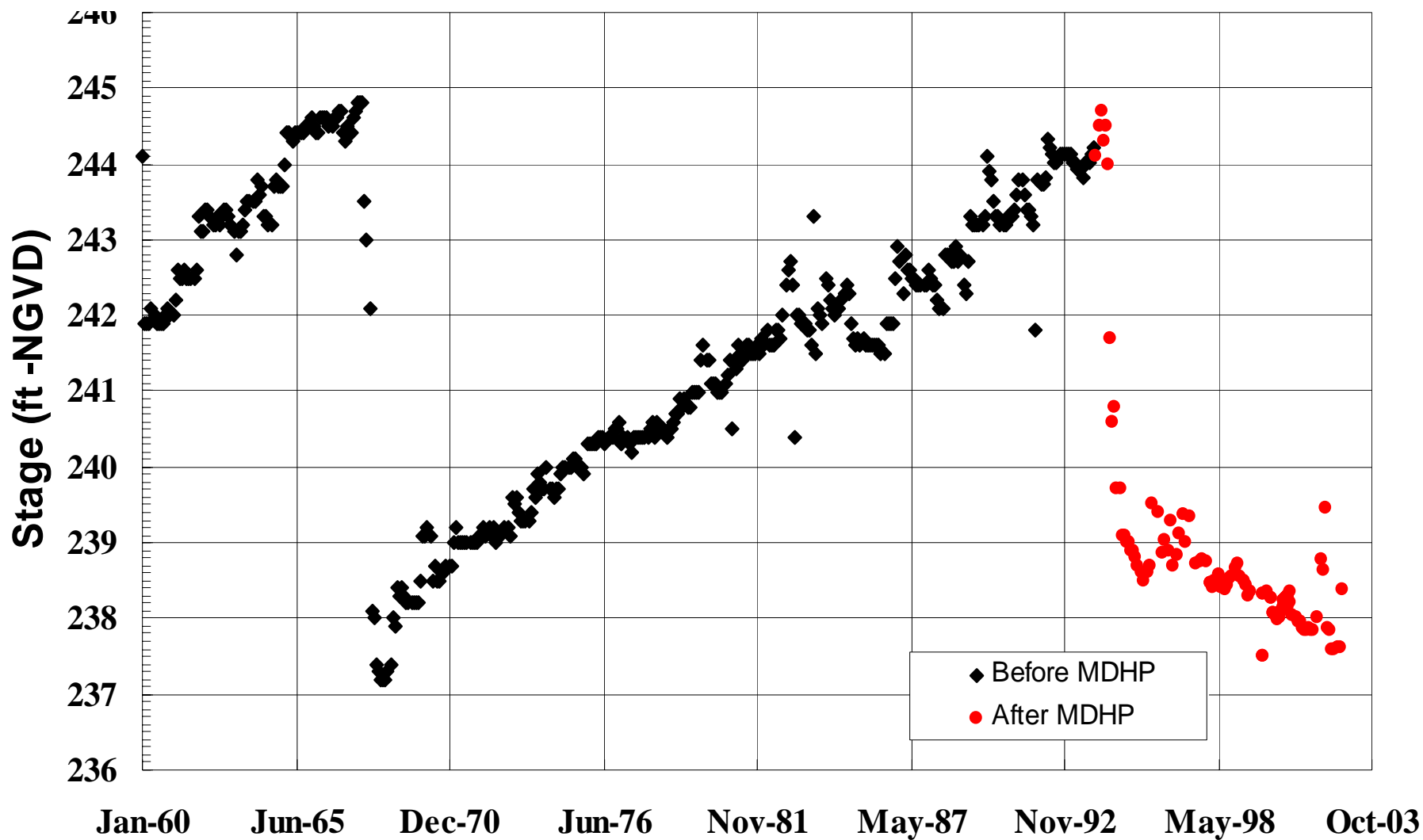


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Results of MDHP Program

- Channel Response
- Structure Performance
- Environmental Impacts
- Impacts on Sediment Yield
- Design Guidance for Systems Approach to Watershed Rehabilitation

Minimum Monthly Gage Readings on Hickahala Creek

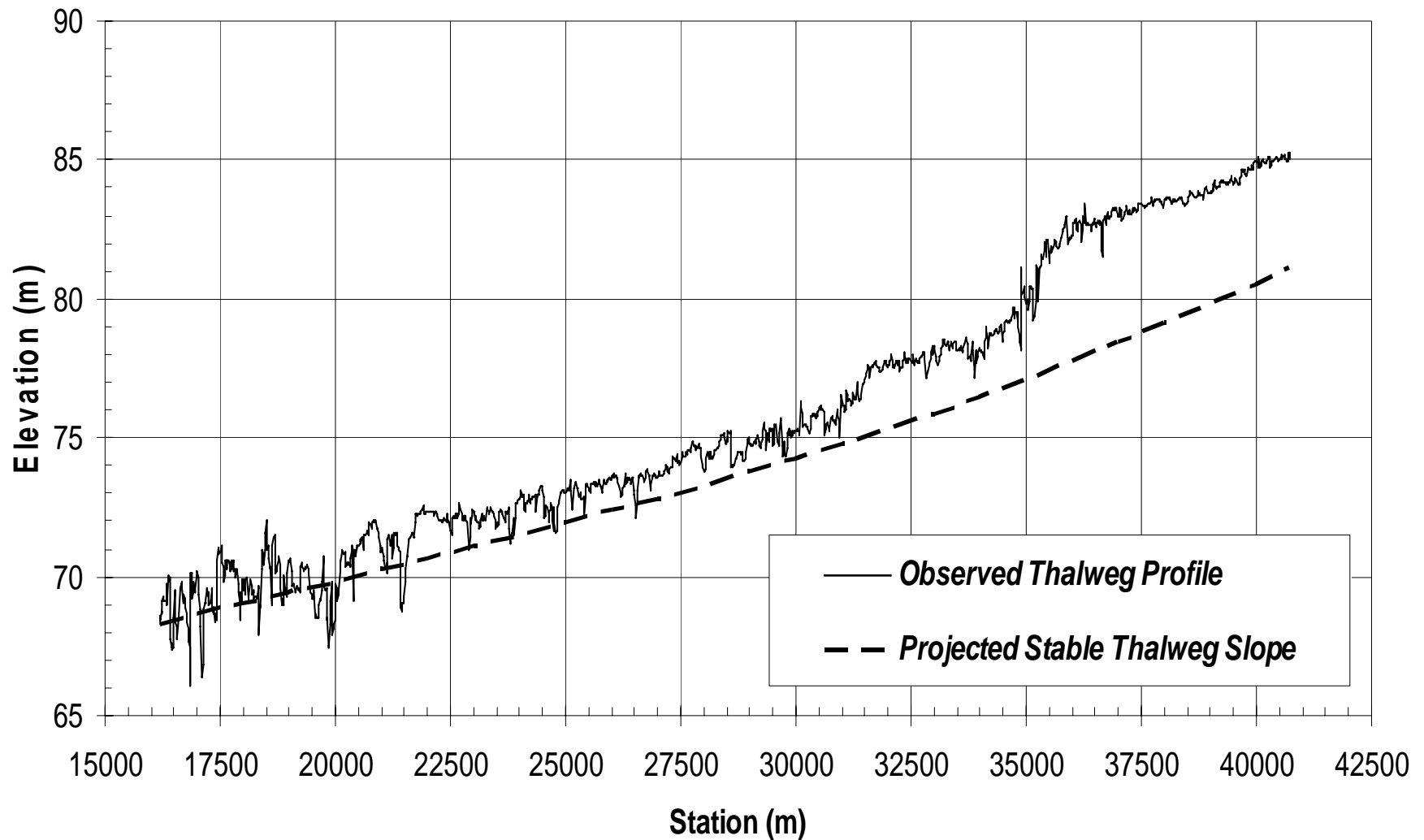




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Effects of MDH Project on Long-Term Sediment Delivery

Yalobusha River Canal Thalweg Profile





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Watershed	Bed & Bank Erosion no/GCS (1000m3)	Bed & Bank Erosion w/GCS (1000m3)	Percent Reduction in Bed & Bank Erosion
Batupan Bogue	180,000	90,000	50%
Hickahala	14,000	4,500	68%
Long	30,000	14,500	52%
Hotophia	5,500	950	83%





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Phosphorus Reductions Due to MDHP Project Features

- Over 500 samples collected in FY 2000
- Average total phosphorus content approximately 200 mg/kg or (0.4 lbs/ton)



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Impacts of Excess Nutrients

- Negative impacts to fish and other wildlife
- Economic impacts resulting from phosphorus removal, BMP
- Contribution to hypoxia problem in the Gulf of Mexico

Phosphorus Reduction Based on 50 Year Response

Watershed	Bed & Bank Erosion Reduction (1000 tons/yr)	Phosphorus Retained (1000 lbs/yr)
Batupan Bogue	3000	1200
Hickahala	300	120
Long	550	220
Hotophia	150	60



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Agricultural best management practices (BMPs) have indicated that some non-point source management programs spend in excess of \$185 per lb of phosphorus reduction per year.



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Phosphorus Benefits Batupan Bogue

- 10% of actual annual phosphorus reduction or 120,000 lbs/yr
- 10% of \$185/lb or \$18.5/lb
- \$2,220,000/yr benefits



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Potential for Nitrogen Reduction and Control



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Modification to Longitudinal Stone Toe-Dike

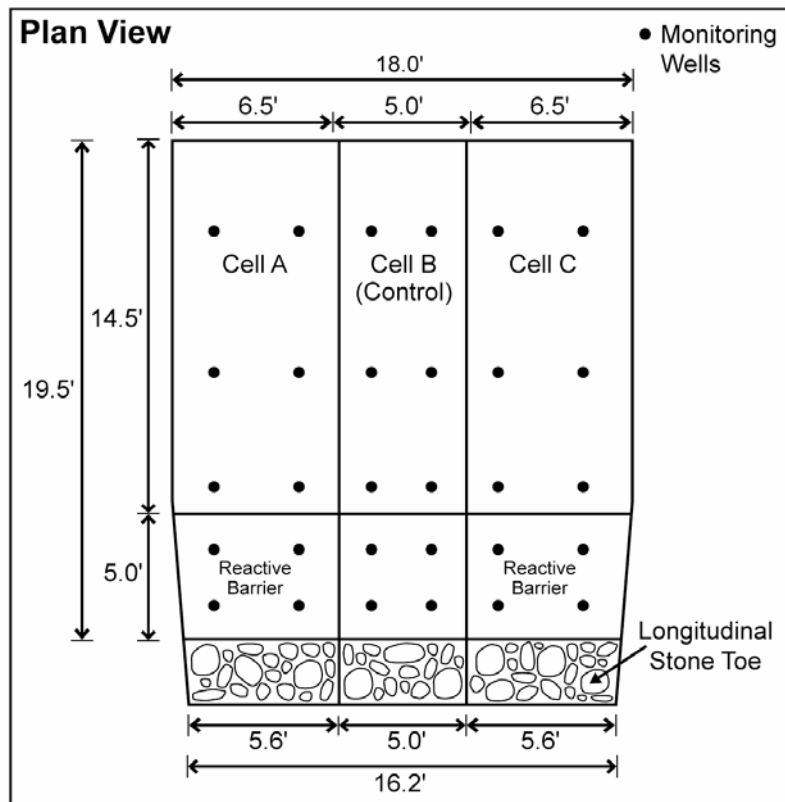
**Irrigation/
Fertilization**

A: Nitrogen Removal

B: Control

**C: Nitrogen & Phosphorus
Removal**

Field Plot



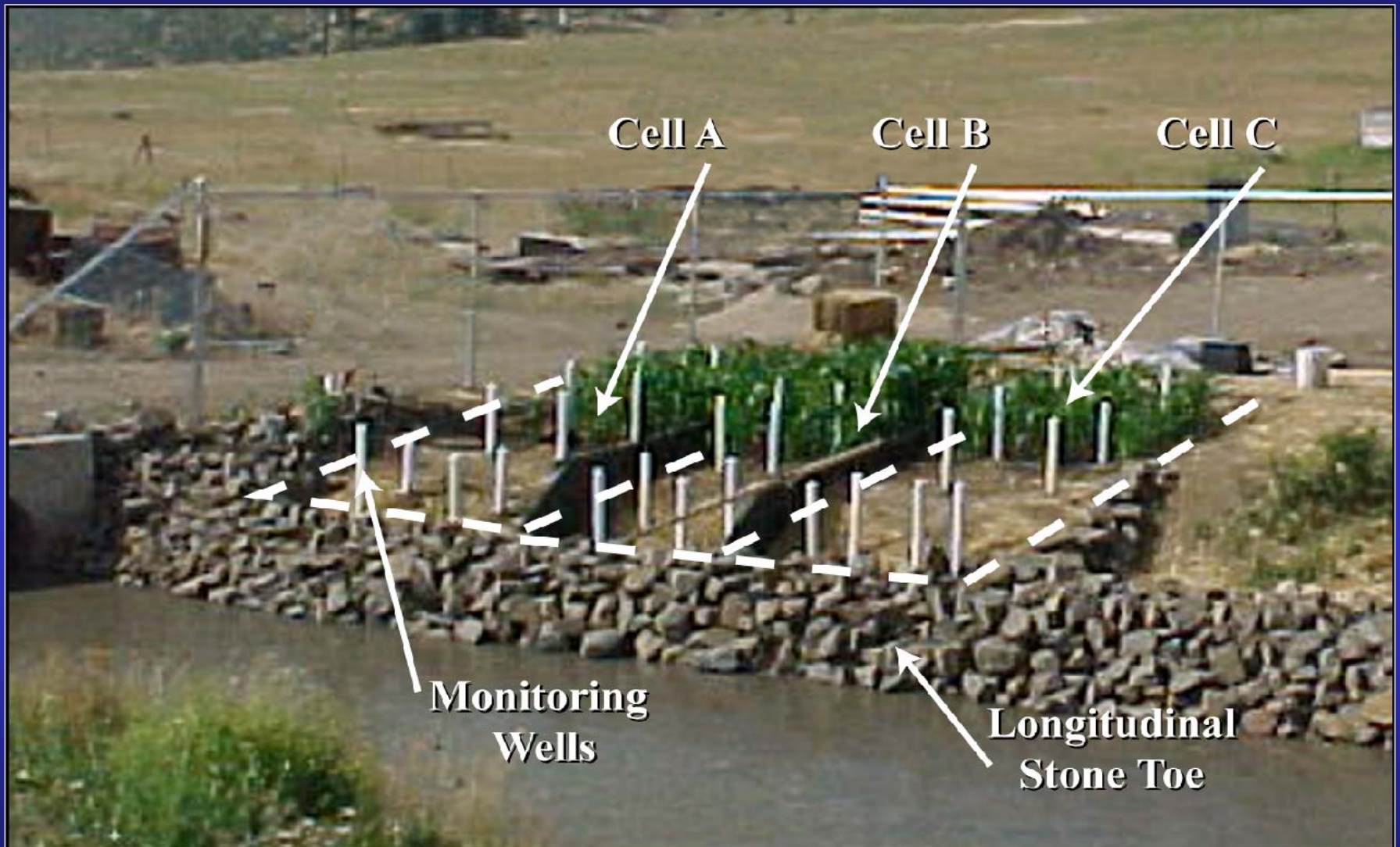
Monitoring Wells

Filter
Fabric

Reactive
Barrier

Longitudinal
Stone Toe

Impermeable Liner



Preliminary Findings of Nutrient Removal Rates

Organic Amendment	Nitrogen	Phosphorus
None	30%	N/A
Sawdust only	60% to 80%	N/A
Sawdust & Aluminum Hydroxide	60% to 80%	>90%



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Benefits of the MDH Project

- Improved understanding of effects of watershed treatments on sediment delivery
- Quantified benefits of watershed treatment measures, particularly with respect to channel stability, sediment delivery and reduction of pollutants
- Improved design guidance for systems approach to sediment management
- Development of effective, lower cost environmentally friendly stabilization measures



Questions?

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